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Yowell

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[54] **MIXING-CUTTING PADDLE**

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 208,737, Mar. 10, 1994, Pat. No. 5,354,129, which is a continuation-in-part of Ser. No. 105,118, Aug. 12, 1993, abandoned.

[51] **Int. Cl.**[6] **B01F 7/18**

[52] **U.S. Cl.** **366/343**; 366/288; 241/282.2

[58] **Field of Search** 99/462, 463; 241/199.12, 241/282.1, 282.2; 366/64, 98, 129, 197, 279, 287, 288, 325, 331, 342, 343, 344

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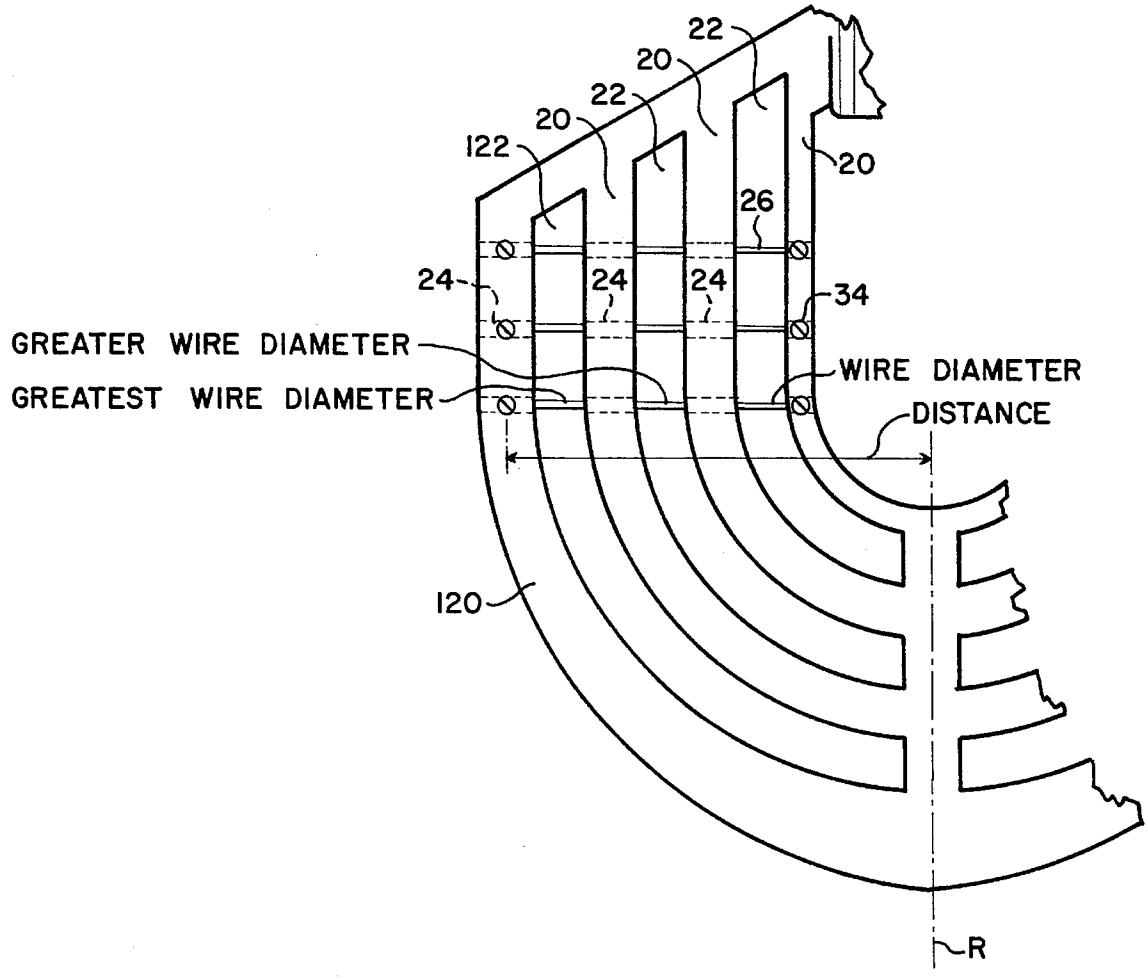
[57] **ABSTRACT**

A paddle is used for mixing and cutting. A hub is at one end of the paddle for connecting the paddle to a planetary mixing machine. The paddle includes a plurality of interconnected arms in a fan-like array which define a plurality of slots between adjacent arms. The arms include a plurality of apertures formed therethrough. Outermost ones of the arms are positioned at opposite sides of the paddle. A plurality of wire members are secured at their opposite ends to the outermost arms. The wire members extend through the apertures formed in the arms and across the slots defined between the arms. The combination of the arms, the wire members extending through the apertures formed in the arms and across the slots defined between the arms, forms a plurality of multidirectional mixing and cutting components of the paddle. Cutting efficiency of the paddle relates to paddle size, mixing speed, mixture density, wire size, number of wires or distance of the wire members from the rotational axis of the paddle.

3 Claims, 3 Drawing Sheets



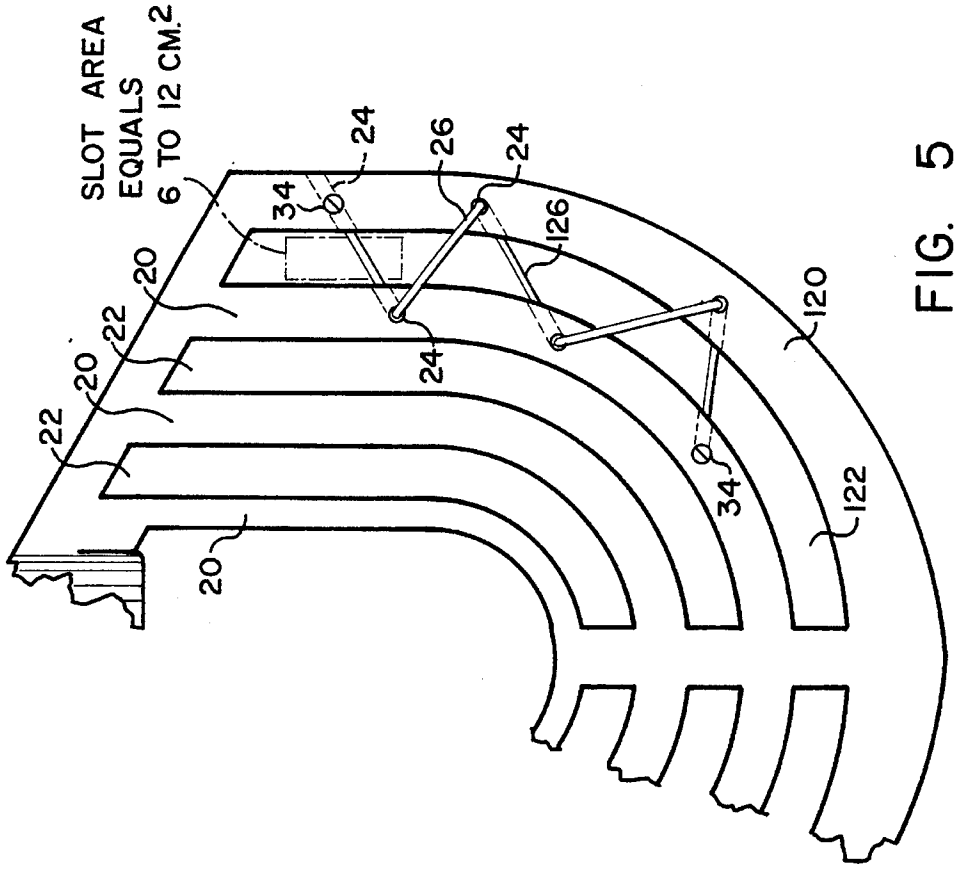

SLOT AREA
EQUALS
6 TO 12 CM.2
24
26
24
34
126
20
22
20
22
24
120
34
122
20

FIG. 5

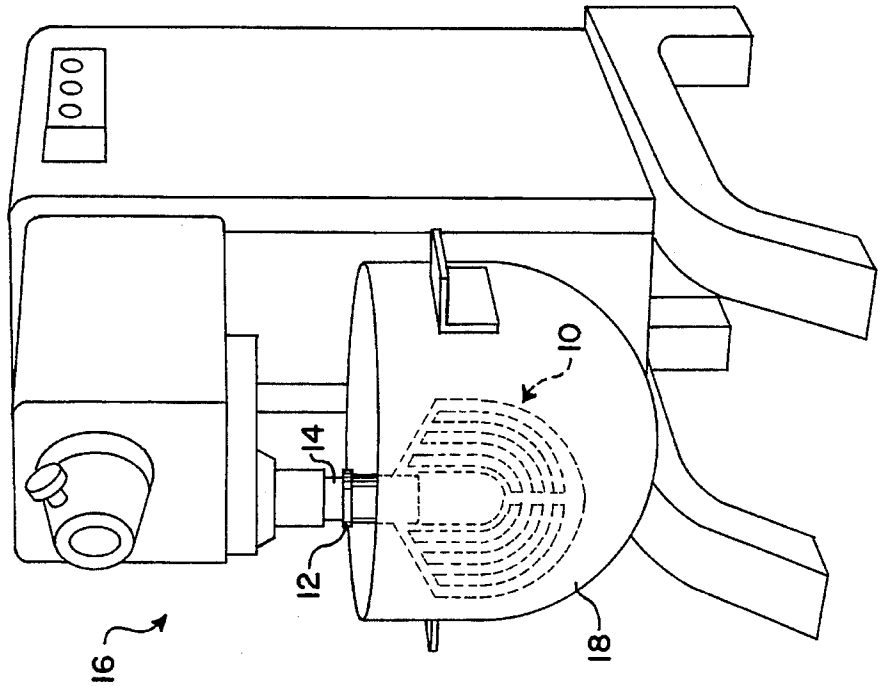

10
14
12
16
18

FIG. 1

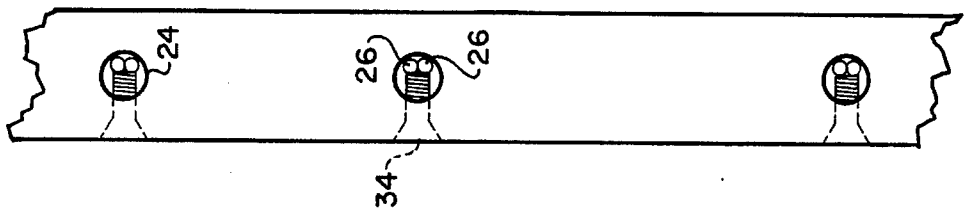

24
26
26
34

FIG. 3

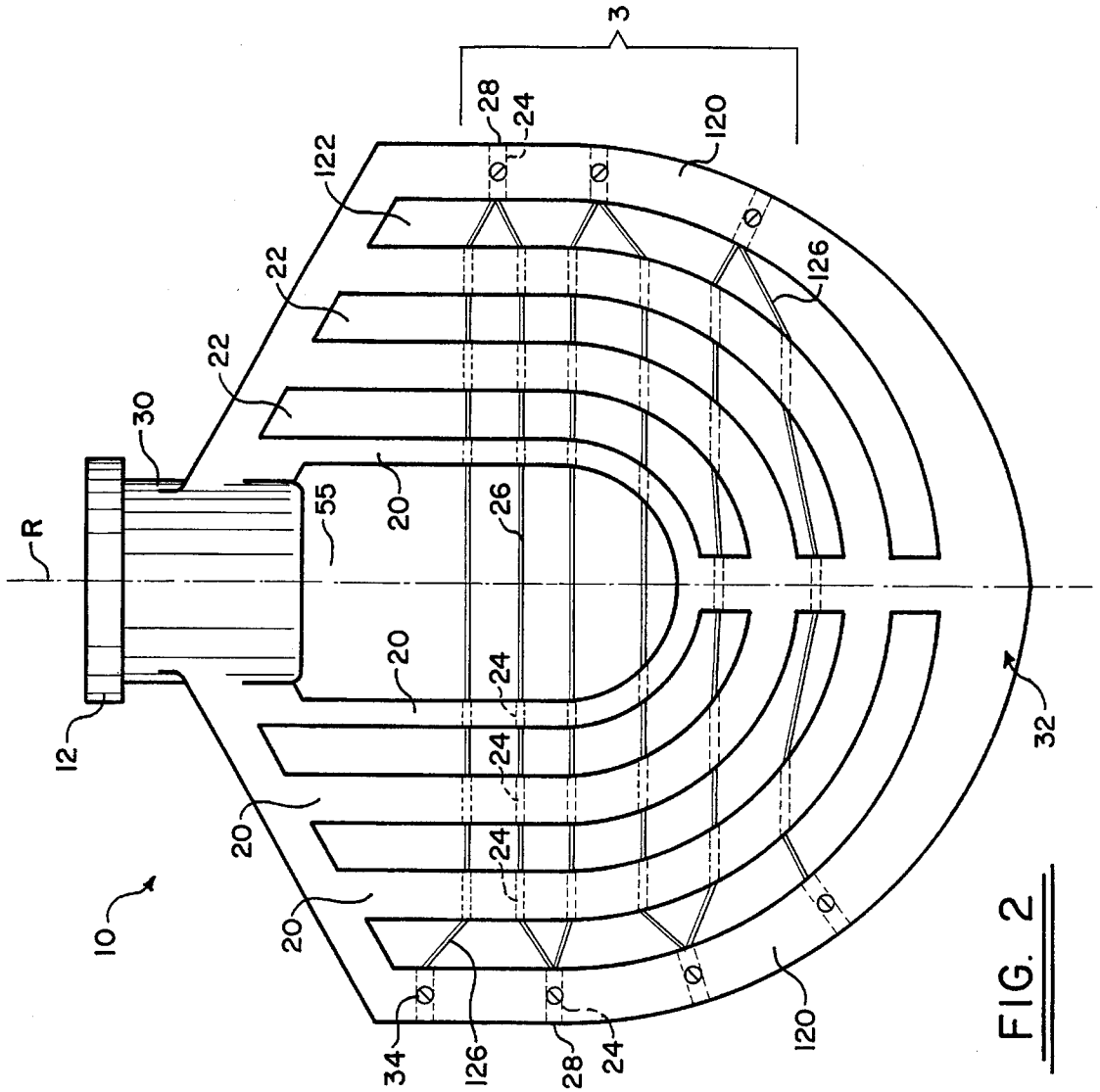

3
28
24
120
122
22
22
126
30
20
26
55
R
20
24
12
24
24
32
20
20
10
34
126
28
24
120

FIG. 2

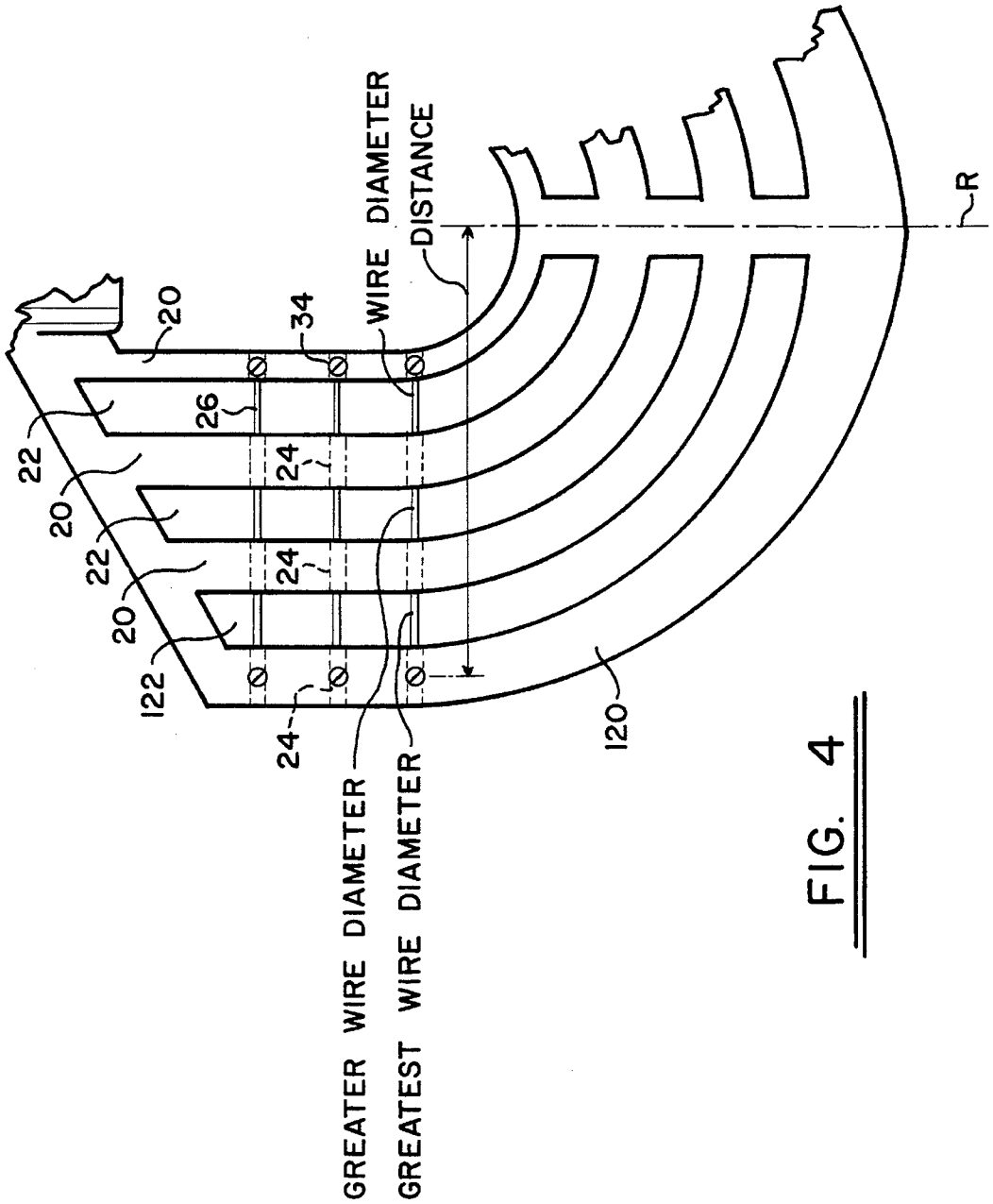

R
WIRE DIAMETER
DISTANCE
20
34
26
24
22
20
22
24
20
122
24
120
GREATER WIRE DIAMETER
GREATEST WIRE DIAMETER

FIG. 4

MIXING-CUTTING PADDLE

This is a continuation-in-part of U.S. patent application Ser. No. 208,737 filed Mar. 10, 1994, now U.S. Pat. No. 5,354,129, which is a continuation-in-part of U.S. patent application Ser. No. 105, 118, filed Aug. 12, 1993, now abandoned, by the inventor in the present patent application.

FIELD OF THE INVENTION

This invention relates generally to a paddle for use with a mixing machine and more particularly to such a paddle having both mixing and cutting components.

BACKGROUND OF THE INVENTION

In mixing operations, especially when blending fat and starch materials used in the food industry, various paddle configurations have been provided for use with planetary mixing machines where the mixed end product is a dry or essentially dry homogeneous powdery-type mixture. By essentially dry is meant that the mixture feels dry to the touch and also appears dry, although some small amounts of moisture may have been added during the mixing operation.

Using such paddles, insufficient cutting of some material will occur and a homogeneous mixture will not be produced. As a result, lumps or chunks of uncut material will remain in the mixture and, no matter how long some materials are mixed, these lumps would not disappear. If a wire whip is used, there will be insufficient structural strength to mix some materials. Wire whips are used for light whipping applications of liquids such as when air is to be incorporated into light batches. The incorporation of air into the dry mixture of the present application is undesirable. Therefore, wire mixing devices are of insufficient strength and totally inappropriate for mixing operations where the mixed end product is a dry or essentially dry homogeneous powdery-type mixture.

The foregoing illustrates limitations of the known prior art. Thus, it is apparent that it would be advantageous to provide an alternative directed to overcoming one or more of the limitations as set forth above. Accordingly, a suitable alternative is provided including features and benefits more fully disclosed hereinafter.

SUMMARY OF THE INVENTION

In one aspect of the present invention, This is accomplished by providing a mixing-cutting paddle comprising a hub at one end of the paddle. A plurality of paddle arms include a fan-like array of interconnected arms defining a plurality of slots between the arms. Outermost ones of the arms are at opposite sides of the paddle. A wire member is secured to the arms. The wire member extends across a slot defined between the outermost arm and an adjacent one of the mixing arms. In this manner, the combination of the arms, and the wire member extending across the slot, forms a plurality of multidirectional mixing and cutting components of the paddle for producing an essentially dry, homogeneous, powdery-type mixture. Paddle cutting efficiency relates to paddle size, mixing speed, mixture density or compactness, wire size, number of wires or distance of the wire from the rotational axis of the paddle.

The foregoing and other aspects will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawing figures. It is to be expressly understood, however,

that the figures are not intended as a definition of the invention, but are for the purpose of illustration only.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

FIG. **1** is a view illustrating an embodiment of the mixing-cutting paddle of the present invention being used with a planetary mixing machine;

FIG. **2** is a view illustrating an embodiment of the mixing-cutting paddle of the present invention.

FIG. **3** is a partial side view of the paddle taken along line **3—3** of FIG. **2**; and

FIGS. **4** and **5** illustrate partial views of alternative embodiments of the mixing-cutting paddle of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings, FIG. **1** illustrates the paddle **10** of the present invention connected at hub **12** to a drive shaft **14** of a typical, well-known planetary type mixer **16**. The standard hub **12** to shaft **14** connection permits interchange of various mixing paddles. A container **18** holds material to be mixed by paddle **10** as the paddle **10** rotates, being driven by shaft **14** while simultaneously revolving in a planetary manner so that the desired mixing is accomplished in container **18**.

In FIG. **2**, it is shown that hub **12** is at one end of paddle **10**. A plurality of paddle arms include a fan-like array of interconnected arms **20** which define a plurality of slots **22** there between. Arms **20** include a plurality of apertures **24** formed therethrough. Outermost ones of arms are at opposite sides of paddle **10** and are designated **120**.

A plurality of wire members **26** are secured at their opposite ends **28** in the apertures **24** formed in the outermost arms **120**. The wire members **26** extend through the apertures **24** formed in arms **20** and **120** and across the slots **22** defined between the arms **20** and **120**. In this manner, the combination of the arms **20**, **120** and the wire members **26** form a plurality of multidirectional mixing and cutting components of paddle **10**.

More specifically, hub **12** is at a first end **30** of paddle **10**. Arms **20**, **120** extend longitudinally, side-by-side from their interconnection at first end **30** of paddle **10** and converge to be interconnected at second end **32** of paddle **10**, thereby defining longitudinally extending slots **22** between the longitudinally extending arms **20**, **120**.

Wire members **26** are strung transversely through the apertures **24** formed to extend transversely through the longitudinally extending arms **20**, **120**. Hence, wire members **26** also extend transversely through the slots **22** defined between arms **20**, **120**. Each wire member **26** includes a diagonal component **126** as it extends through the outermost ones of the slots **122** adjacent the outermost arms **120**. Means, such as set screws **34**, are provided to secure the opposite ends **28** of wire members **26** in the apertures **24** of the outermost arms **120**. It is preferable to countersink set screws **34** into outermost arm member **120**, best shown in FIG. **3**.

Wire members **26** thus form a plurality of longitudinally spaced apart, transversely extending rows as they pass through corresponding rows of apertures **24**. The apertures **24** formed in the outermost arms **120** are longitudinally offset from the apertures **24** in the arms **20**. Due to this offset,

the diagonal components **126** of adjacent ones of the wire members **26** are formed as the adjacent wire members **26** converge into a common aperture **24** in the outermost arms **120**, where they are secured by set screws **34**. The wire members **26** are preferably formed of stainless steel and have a diameter which may vary as discussed below.

The mixing-cutting paddle **10** of the present invention may be used for mixing operations in the food industry, the pharmaceutical industry or the chemical industry, and is particularly useful for blending fat with starch, but facilitates mixing of relatively small amounts of liquid with an insoluble, finely divided powder where the end mixed product is a dry or essentially dry homogeneous powdery-type mixture. The paddle **10** simultaneously mixes and cuts with enhanced efficiency. The arrangement, number and size of the wire members **26** may be varied somewhat, however, it has been noted that the diagonal components **126** of the wire members **26** are most effective, especially in the outermost slots **122**, due to the greater relative speed generated between that area of the paddle **10** and the material being mixed. In fact, the wire members **26** can be totally eliminated in the region of the paddle **10** which lies along the rotational axis R of the hub **12** since there is little relative speed between this area of the paddle **10** and the material being mixed, for example see FIGS. **4** and **5**.

The unique mixing-cutting paddle of this invention combines the structural strength of the beater arms so that greater mixing speeds can be used, and the combination of wires of a small diameter, extending across the slots defined between the beater arms, enhances cutting and helps prevent oxidation. The wires must be of small enough diameter to enhance cutting, but of sufficient strength so as not to break during mixing. Not only do the wires allow difficult materials to be cut while being mixed, they produce a mixing process which is completely homogeneous and efficient when combined with the strong beater arms of the mixing paddle. Unexpectedly, the mixing-cutting paddle of this invention maximizes the chemical integrity of the mixture by minimizing oxidation.

FIGS. **4** and **5** illustrate alternative ways to string wire members **26** in paddle **10**. In FIG. **4**, wire members **26** do not include diagonal components **126**, but are strung in substantially a straight line between an arm **20** and outermost arm **120**. The wire members **26** extend through apertures **24** in arms **20, 120** and across slots **22, 122** and are secured at their opposite ends by set screws **34**.

In FIG. **5**, wire members **26** do include diagonal components **126** which are strung only across outermost slot **122**, the most effective mixing and cutting area, between outermost arm **120** and an adjacent arm **20**. Wire member **26** extends through apertures **24** in arms **20, 120** and opposite ends of wire member **26** are secured in arms **20, 120** by set screws **34**.

A few general parameters have been discovered. Smaller wire diameters are more reliable for smaller paddle sizes, and vice versa. The paddle sizes investigated were for mixers of the 10, 30, 60, 80 and 140 quart sizes. An acceptable range of wire diameters is from about 0.005 inches to about 0.050 inches. The preferred range is 0.010 inches to 0.025 inches. The best wire diameter to work well with any size paddle is 0.016 inches. However, although a uniform wire diameter can be used across all the slots, the wire diameter can be varied to decrease as the distance from axis R decreases, since the mixing stresses on the wire are less as the distance from axis R decreases. Further, a preferred number of wire members in a slot has been found to be wire per 6 to 12 cm^2 of slot area. It has also been found that paddle cutting efficiency increases in response to a decreased wire diameter, increased paddle size, increased number of wires, increased mixture density or compactness, increased mixing speed or increased distance of the wire from the rotational axis.

While this invention has been illustrated and described in accordance with a preferred embodiment, it is recognized that variations and changes may be made therein without departing from the invention as set forth in the claims.

Having described the invention, what is claimed is:

1. A mixing-cutting paddle comprising:

a hub at a first end of the paddle, the hub having a rotational axis;

a plurality of paddle arms including a fan-like array of longitudinally extending arms interconnected at the hub and extending therefrom the arms being side-by-side and spaced apart defining longitudinally extending slots therebetween, the arms converging and being interconnected at a second end of the paddle opposite the first end, outermost ones of the arms being at opposite sides of the paddle;

a plurality of wire members strung transversely through apertures formed in the arms and extending transversely through the slots, each wire member including a diagonally extending portion as it extends through outermost ones of the slots adjacent the outermost arms;

means for securing opposite ends of each wire member in the outermost arms, whereby the combination of paddle arms and wire members extending through the slots, forms a plurality of multidirectional mixing and cutting components of the paddle for producing an essentially dry, homogeneous, powdery-type mixture;

wherein paddle cutting efficiency is increased in response to decreased wire diameter; and

wire diameter is decreased as the distance from the rotational axis is decreased.

2. The paddle according to claim **1** wherein the slots contain one wire for each six to twelve square centimeters of slot area.

3. A mixing-cutting paddle comprising:

a hub at a first end of the paddle, the hub having a rotational axis;

a plurality of paddle arms including a fan-like array of longitudinally extending arms interconnected at the hub and extending therefrom, the arms being side-by-side and spaced apart defining longitudinally extending slots therebetween, the arms converging and being interconnected at a second end of the paddle opposite the first end, outermost ones of the arms being at opposite sides of the paddle;

a plurality of wire members strung transversely through apertures formed in the arms and extending transversely through the slots;

means for securing opposite ends of each wire member in the outermost arms, whereby the combination of paddle arms and wire members extending through the slots, forms a plurality of multidirectional mixing and cutting components of the paddle for producing an essentially dry, homogeneous, powdery-type mixture;

the slots contain one wire for each six to twelve square centimeters of slot area; and

wire diameter is decreased as the distance from the rotational axis is decreased.

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